OBSERVATIONS OF SELECTED CORONAE FROM VENUSIAN QUADRANGLES V31 AND V19; Duncan L. Copp[1], John E. Guest[1] and Ellen R. Stofan[2]. E-mail dlc@star.ucl.ac.uk. [1]University of London Observatory, NW7 2QS, UK. [2]JPL, California Institute of Technology, Pasadena, CA 91109.

Introduction

Observations from FMAP images and topographic data reveal coronae within V31 and V19 to have a more complex, protracted history than previously recorded [1-3]. Five coronae are studied in detail; Idem-Kuva and Nissaba coronae (25^0 N, 358^0 E, 26.5^0 N 355.5^0 E respectively) situated on the Western Eistla Rise, Heng-o (2^0 N 355^0 E) Benten (14.2^0 N, 341^0 E) and Silvia (12.5^0 N, 355.5^0 E) coronae, contained within the Guinevere Lineated and Mottled Plains and Guinevere Regional Plains units [4,5].

Corona Formation

A three stage evolutionary sequence for coronae formation has been previously proposed [1-3]: initial uplift with interior faulting and volcanism, formation of an annulus and possibly a surrounding trough, and final relaxation.

Idem-Kuva, Nissaba, and Silvia coronae all contain materials which are inferred to be older than the plains materials which surround them. We interpret these materials as relic plains which have been uplifted and subsequently deformed by later stage corona development. The degree of initial deformation and volcanism varies considerably between the five coronae. Heng-o and Benten Coronae show the greatest amount of interior deformation, predominately graben which have different orientations to those observed in the adjacent annulus, while Nissaba and Silvia show relatively little deformation. We see no evidence for early *radial* graben at any of the coronae. Benten Corona has two extensive flow fields which were subsequently deformed by annulus formation, and followed by a third phase of volcanism. Idem-Kuva, Nissaba and Silvia Coronae do not display any extensive early stage volcanic units, however, it is possible that they have been superposed by later regional plains materials and are no longer visible.

The formation of the annulus and trough has been associated with the second stage of corona formation [1-3]. All five coronae have some degree of annulus deformation, although the amount and style differs considerably between each. Idem-Kuva and Heng-o show evidence for more than one phase of annulus formation. With Idem-Kuva multiphase deformation is represented by some arcuate graben, associated with the south-western annulus, which do not conform with the topographic rim of the corona. Furthermore, the SW region of the annulus has a ‘terraced’ appearance. Heng-o shows older embayed annulus deformation as well as younger deformation which post-dates the regional plains. Benten Corona shows late stage radial graben which post-date annulus formation, and are interpreted as a later phase of uplift.

The theory that older coronae have lower relief owing to gravitational relaxation during the third stage of coronae formation [6-8] is not substantiated from our observations. Topographic profiles for the five coronae in our study area show no correlation between age and relief. Heng-o has a relatively low relief and yet the main annulus post-dates regional plains formation, hence is a relatively young corona. In contrast, Idem-Kuva, which is embayed by regional plains materials has greater relief. We infer that the amount of relief at any individual corona is more strongly controlled by the amount of uplift and/or volcanic construction which has taken place, and that not all coronae may go through a dome or plateau-shaped phase.

Corona Stratigraphy

A number of workers suggest a specific age of formation for coronae on Venus using both local stratigraphy [9-11] and crater densities [12-14]. Some workers [9-11] have recognised three distinct stratigraphic classes of deformation which are described as being contemporaneous on a global scale; COdf, the oldest unit representing interior radial or chaotic deformation; COar, ridges of the corona annuli, and COaf, which represents the youngest unit composed of fractures of the corona annuli. However, we do not observe any simplistic relationships between structural deformation and time-stratigraphic units at the five coronae studied here. Furthermore, two of our coronae show evidence of more than one phase of annulus formation. Also interior deformation is not always relatively old.

Regarding crater statistics, it has been shown that the minimum area needed to produce statistically meaningful crater densities for Venus, having 891 craters, is approximately $5x10^6$ km^2 [15]. This corresponds to a circle with a diameter of approximately 1300 km. Only one corona (Artemis) is larger than this stipulation. An attempt to estimate the age of coronae using crater statistics [12-13] used an area-weighted mean calculation. This has inherent problems because an area weighted mean calculation will smooth the age range of coronae, hence the shape of the age distribution and its span are not determined. Furthermore it has been shown that a total of 319 coronae, 89% of the population, contain no impact craters [14].

The average age for coronae calculated using the weighted mean method corresponded to 120 ± 115 Ma, compared to approximately 300 Ma for the regional plains [13]. However, from the observations presented here we have shown that coronae both pre and post-date formation of the adjacent plains, and can have a long complex geologic history.

Conclusions

Our observations of five coronae within the venusian quadrangles V31 and V19, show that the formation of coronae is more complex than previously described. Coronae may or may not show evidence of broad interior uplift and early stage deformation. Evidence for multi-stage annulus formation is observed at two of the five coronae and, in addition, small scale structures (which compose the annulus) and rim topography formation do not necessarily coincide. The amount and style of volcanism observed at different coronae may differ significantly.

Regarding stratigraphy, the calculation of an average age for coronae using impact craters is prone to gross errors; the relative age of individual corona should only be obtained by detailed mapping to establish its relationship with the surrounding units. The extrapolation of corona units on a global scale may be misleading.

References

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